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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|-------------|----------------------|---------------------|------------------|
| 09/762,582 | 04/12/2001 | Akihisa Hongo | 2001-0133A | 5731 |
| 513 | 7590 | 06/02/2004 | EXAMINER | |
| WENDEROTH, LIND & PONACK, L.L.P. 2033 K STREET N. W. SUITE 800 WASHINGTON, DC 20006-1021 | | | MUTSCHLER, BRIAN L | |
| | | ART UNIT | PAPER NUMBER | |
| | | 1753 | | |

DATE MAILED: 06/02/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

| | | |
|------------------------------|------------------------|---------------------|
| Office Action Summary | Application No. | Applicant(s) |
| | 09/762,582 | HONGO ET AL. |
| | Examiner | Art Unit |
| | Brian L. Mutschler | 1753 |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 30 March 2004.
- 2a) This action is FINAL. 2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) Claim(s) 36-48 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) Claim(s) _____ is/are allowed.
- 6) Claim(s) 36-48 is/are rejected.
- 7) Claim(s) _____ is/are objected to.
- 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on _____ is/are: a) accepted or b) objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) All b) Some * c) None of:
1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____ | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on March 30, 2004, has been entered.

Comments

2. Applicant's cancellation of claims 24-35 and addition of claims 36-48 in the response received on March 30, 2004, is acknowledged.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims 36-38 and 48 are rejected under 35 U.S.C. 102(e) as being anticipated by Hanson et al. (U.S. Pat. No. 6,091,498).

Regarding claim 36, Hanson et al. disclose an apparatus for plating a surface of a substrate, wherein the apparatus comprises a frame, a load/unload unit **12**, a transfer mechanism **62, 64** and a plurality of processing units **20, 22, 24** surrounding the transfer mechanism (figs. 11, 2, 10 and 11).

Regarding claim 37, the transfer mechanism is linearly movable along paths **68, 70** (fig. 2; col. 6, lines 12-28).

Regarding claim 38, the apparatus comprises an electrolytic plating unit **810** (fig. 11; col. 9, lines 8-24).

Regarding claim 48, the frame of the apparatus is rectangular in shape (figs. 1, 2, 10, and 11).

Since Hanson et al. teach all of the limitations recited in the instant claims, the reference is deemed to be anticipatory.

5. Claims 36, 37, and 48 are rejected under 35 U.S.C. 102(e) as being anticipated by White et al. (U.S. Pat. No. 6,235,634).

Regarding claim 36, White et al. teach an apparatus for plating a substrate, wherein the apparatus comprises a frame (shown generally as the channel **80**), a load/unload unit **60**, a transfer mechanism **70**, and a plurality of processing units **50, 52, 54** surrounding the transfer mechanism (fig. 2).

Regarding claim 37, the transfer mechanism is linearly movable (fig. 2).

Regarding claim 48, the frame has a rectangular shape (fig. 2).

Since White et al. teach all of the limitations recited in the instant claims, the reference is deemed to be anticipatory.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claim 39 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hanson et al. (U.S. Pat. No. 6,091,498) in view of Ting et al. (U.S. Pat. No. 6,017,437).

Hanson et al. disclose an apparatus having the limitations recited claims 36-38 and 48 of the instant invention, as explained above in section 4.

Hanson et al. further teach the use of a rinsing and drying module **805** (fig. 11; col. 9, lines 8-24).

The rinsing and drying module of Hanson et al. differs from the instant invention because Hanson et al. do not disclose that the module is capable of spin-drying the substrate, as recited in claim 39.

Ting et al. disclose an apparatus for electroplating a semiconductor comprising an electroplating bath and a rinsing (cleaning) and drying device capable of spinning to enhance rinsing and drying (col. 11, line 57 to col. 12, line 6).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the rinsing and drying module in the apparatus of

Hanson et al. to use a cleaning and drying device capable of spinning as taught by Ting et al. because spinning enhances rinsing and drying.

8. Claims 40 and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hanson et al. (U.S. Pat. No. 6,091,498) in view of Uzoh et al. (U.S. Pat. No. 6,140,234).

Hanson et al. disclose an apparatus having the limitations recited claims 36-38 and 48 of the instant invention, as explained above in section 4.

Regarding claim 40, Hanson et al. further teach that the apparatus is used for plating copper interconnects and that a seed layer is first deposited using one or more of several processes before electroplating (col. 1, lines 38-64). Hanson et al. provide examples of CVD or PVD as a method for forming the seed layer (col. 1, lines 47-51).

Regarding claim 41, Hanson et al. disclose that the apparatus further comprises a processing unit for pre-treating the substrate prior to electroplating (col. 9, lines 8-24).

The apparatus of Hanson et al. differs from the instant invention because Hanson et al. do not disclose the use of an electroless plating unit, as recited in claim 40.

Uzoh et al. disclose a method for plating a semiconductor substrate comprising the steps of depositing a seed layer **6** by an electroless plating method or CVD method (col. 3, lines 66-67) followed by forming a conductive metal layer **8** by electroplating copper on the seed layer **6** using a plating bath (col. 4, lines 25-47). An apparatus comprising plating baths is inherent in the use of the method.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the apparatus of Hanson et al. to use an electroless plating unit as taught by Uzoh et al. because Uzoh et al. teach that electroless plating the seed layer is an effective means of preparing a copper seed layer prior to electroplating and that electroless plating and CVD can be equivalently used to form a seed layer.

9. Claims 42-47 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hanson et al. (U.S. Pat. No. 6,091,498) in view of Uzoh et al. (U.S. Pat. No. 6,140,234), as applied above to claims 40 and 41, and further in view of Uzoh (U.S. Pat. No. 6,117,784) and in view of either Dahms et al. (U.S. Pat. No. 5,849,171) or Dahms et al. (U.S. Pat. No. 5,433,840), herein referred to as US '171 and US '840, respectively.

Hanson et al. and Uzoh et al. disclose an apparatus having the limitations recited claims 40 and 41 of the instant invention, as explained above in section 8.

Hanson et al. further disclose that the apparatus is used to electroplate copper on a substrate (col. 1, lines 18-24).

Regarding claims 42-47, Uzoh et al. (US '234) further disclose that the plating solution comprises an acidic copper plating bath having sulfuric acid, copper sulfate, chloride ions and brighteners such as polyalkylene glycols (the compounds having the basic formula recited in claim 46 of the instant application) (col. 4, lines 25-64).

Additionally, Uzoh et al. disclose the use of other additives, such as sulfur-containing

compounds (disulfides and safranine-type dyes), and nitrogen containing compounds (col. 4, lines 48-64).

The apparatus described by Hanson et al. and Uzoh et al. differs from the instant invention because they do not disclose the following:

- a. The electroless plating bath has a concentration of copper sulfate of 100 to 250 g/L, as recited in claim 42.
- b. The electroless plating bath has a concentration of sulfuric acid of 10 to 100 g/L, as recited in claim 43.
- c. The electroless plating bath has a concentration of chlorine ions of 0 to 100 mg/L, as recited in claim 44.
- d. The electroless plating bath has a sulfur compound expressed by the formula $X-L-(S)_n-L-X$ at a concentration of at least 0.14 to 70 $\mu\text{mol}/\text{L}$, as recited in claim 45.
- e. The electroless plating bath has a macromolecular compound expressed by the formula
$$\begin{array}{c} R_2 & & R_3 \\ | & & | \\ R_1-(\text{CH}_2\text{CHO})_m-(\text{CH}_2\text{CHO})_k-\text{H} \end{array}$$
at a concentration of 10 to 5000 mg/L, as recited in claim 46.
- f. The electroless plating bath has a nitrogen compound at a concentration of 0.01 to 100 mg/L, as recited in claim 47.

In US '784, Uzoh discloses a method similar to the method disclosed by Uzoh et al. in US '234 to form a wiring pattern on a semiconductor substrate. The copper may be electroplated or electrolessly plated using an acidic copper plating bath having the

same components as the bath disclosed in US '234: copper sulfate, sulfuric acid, chloride ions, polyalkylene glycols, sulfur-containing compounds and nitrogen-containing compounds (col. 3, line 38 to col. 4, line 9).

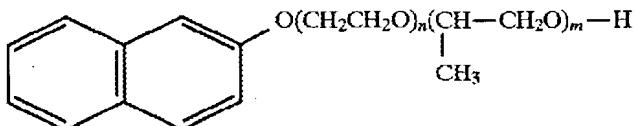
It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modify the plating bath in the apparatus described by Hanson et al. and Uzoh et al. to use an acidic plating bath having the components disclosed by Uzoh et al. for electrolessly plating copper because in US '784, Uzoh teaches that copper can be electroplated or electrolessly plated using an acidic copper plating bath.

Regarding claims 42-47, US '171 discloses a plating solution for plating copper, wherein plating bath contains a solution comprising 20-250 g/L of copper sulfate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$), 50-350 g/L of sulfuric acid (H_2SO_4), and 0.02-0.25 g/L of sodium chloride (NaCl), which provides chlorine ions at a concentration of 12-151 mg/L (col. 4, lines 15-28).

US '171 also discloses the use of a sulfur-containing additive, which can include bis-(w-sulfopropyl)-disulfide disodium salt, which has the chemical formula, $\text{NaSO}_3(\text{CH}_2)_3\text{S-S}(\text{CH}_2)_3\text{SO}_3\text{Na}$ (col. 4, lines 54-67). The sulfur-containing brightening agent (M.W. 354) is supplied at a concentration of 0.01 g/L, which equates to a concentration of 28 $\mu\text{mol}/\text{L}$ (col. 4, line 55).

The plating solution in Example 1 of US '171 further comprises 0.02 g/L (20 mg/L) of a nitrogen-containing compound, 7-dimethylamino-5-phenyl-phenazonium chloride (col. 4, lines 57-58).

US '171 also discloses the use of polyethylene glycol and polypropylene glycol polymers and copolymers having the basic formula recited in formula [B] of the instant invention. The plating solution contains a β -naphtholalkoxylate shown by the general formula below, where n=0-50 and m=0-50:



In Example 1, US '171 teaches the use of 25 mg/L of the β -naphtholalkoxylate shown above, as well as 200 mg/L of polyethylene glycol (col. 4, line 54 to col. 5, line 4).

When the plating bath taught in US '171 is used, the plating has "a mirror finish and is well smoothed" and has no voids (col. 5, lines 1-4).

Regarding claims 42-47, US '840 discloses a plating solution and a method for using a plating solution for plating the conductors of printed circuits, wherein the plating solution comprises 20-250 g/L of copper sulfate (CuSO₄•5H₂O), 50-350 g/L of sulfuric acid (H₂SO₄), and 10 to 180 mg/L of chloride ions (col. 3, lines 68 to col. 4, line 8).

US '840 discloses the use of 7-dimethylamino-5-phenyl phenazonium chloride, which is a nitrogen-containing compound (col. 4, lines 45-46).

US '840 discloses the use of bis-(ω -sulfopropyl)disulfide, disodium salt, which has the chemical formula, NaSO₃(CH₂)₃S-S(CH₂)₃SO₃Na (col. 4, lines 41-42). The

sulfur-containing brightening agent (M.W. 354) is supplied at a concentration of 0.01 g/L, which equates to a concentration of 28 μ mol/L (col. 4, line 41-42).

US '840 teaches the use of polyethylene glycol and polypropylene glycol in concentrations of 0.2 g/L and 0.6 g/L, respectively (col. 4, lines 40-68). Both polyethylene glycol and polypropylene glycol have chemical formulas contained in Formula [B]. The molecular weight of the polyalkylene glycols is between 500 and 35000 g/mol (col. 2, lines 2-4), which corresponds to a value of m+k of about 8 to about 800, wherein m=k because the repeating unit is the same.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the electroless plating bath described by Hanson et al. and Uzoh et al. to use a plating bath having the composition taught by Dahms et al. in either US '171 or US '840 because both solutions have been shown to plate copper having a smooth uniform surface with no voids.

Response to Arguments

10. Applicant's arguments with respect to claims 24-35 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brian L. Mutschler whose telephone number is (571)

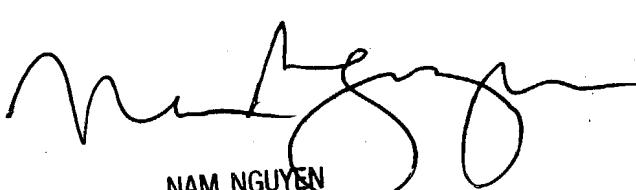
Art Unit: 1753

272-1341. The examiner can normally be reached on Monday-Friday from 7:30am to 4:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

BLM
May 26, 2004



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SUPERVISORY PATENT EXAMINER
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